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FINAL REPORT ON CONTRACT F49620-79-C-0164.(U)
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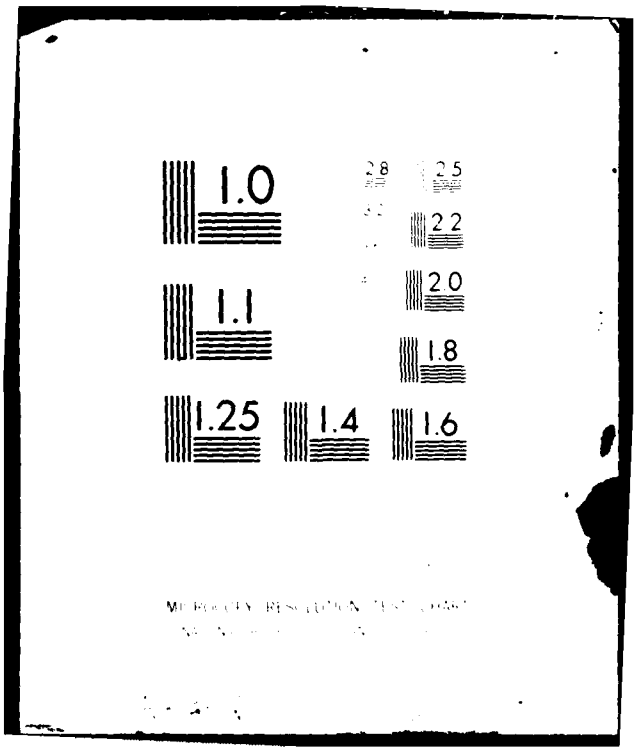
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November 30, 1981

FINAL REPORT

AFSC contract F49620-79-C-0164

Principal Investigator: David Pollard

The main achievement of the research conducted under this contract was the sharpening of techniques for studying the asymptotic behaviour of the empirical measure P_n constructed from independent sampling on a distribution P. The best results obtained used symmetrization and combinatorial methods to bound the deviations of P_n from P. This gave central limit theorems for $n^{\frac{1}{2}}(P_n - P)$, which generalized the classical Donsker theorem for empirical distribution functions [2], [4]. These were applied to determine the limiting distribution of some statistics expressible as functionals $T_n P_n$ of the empirical measure, as in the central limit theorem for the optimal k-means cluster centres [5]. It turned out that these methods also had applications to the communications problem of quantization. The invited paper [6] explores one such connection.

Gary Oehlert and Adrian Baddeley were supported as research assistants during parts of the contract period. Gary completed a Ph.D. on the asymptotic behaviour of alternative estimators of the mean; he now holds the position of Assistant Professor of Statistics at Princeton. Adrian contributed a lot of geometric know-how to the k-means problem. Some of our theoretal expectations of the rotational instability of these estimators are now being detected for practical quantization algorithms.

As a by-product of this work and related graduate courses, a new approach to the study of weak convergence methods has emerged. Pursuit of this approach and a widening of the applications of the empirical process tools -- to cover rank tests, estimation from censored data, and other problems in quantization -- seems the natural next step.

Publications:

[1] Strong consistency of k-means clustering. Ann. Statistics 9 (1981), 135-140.

[2] Limit theorems for empirical processes. Z. Wahrscheinlichkeitstheorie und verw. Geb. 47 (1981), 181-195.

[3] Beyond the heuristic approach to Kolmogorov-Smirnov theorems. In: Festschrift fur P.A.P. Moran (1982) -- to appear.

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Empirical processes, central limit theorem, quantization, k-means clustering.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A central limit theorem for empirical processes was proved. Applications to the electrical engineering problem of quantization and the statistical k-means clustering procedure were explored.

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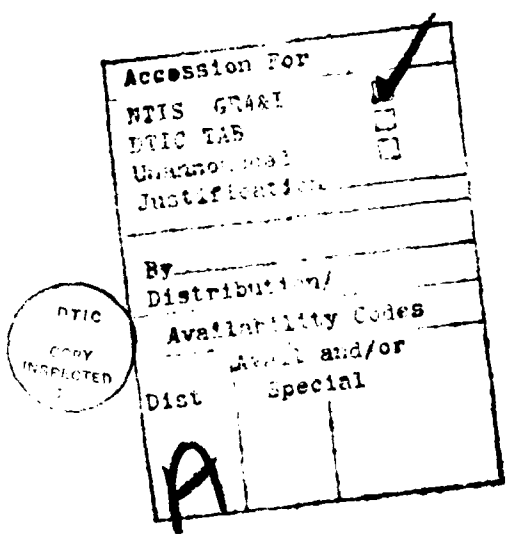
[4] A central limit theorem for empirical processes. J. Australian Math. Soc. (1982) -- to appear.

[5] A central limit theorem for k-means cluster centres. Ann. Probability (198?) -- to appear.

[6] Quantization and the method of k-means. IEEE Transactions on Information Theory (Special issue on quantization) 28 (1982) -- to appear.

PROPERTY INVENTORY

No property items were purchased under this contract, so there is no property to inventory.

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